with respective users of the appliance. Additionally, the one or more data processors are configured to match the face detected in the acquired frame with one of the target faces based on a result of the analysis, and to acknowledge the match of the detected face in accordance with a profile stored on the data storage device and associated with the matched user of the appliance.

[0010] These and other implementations can include one or more of the following features. The data storage device is further configured to store rules for analyzing the weighted differences including weighting rules and scoring rules, and rules for matching the detected face against target faces.

[0011] Particular implementations of the subject matter described in this specification can be configured to realize one or more of the following potential advantages. The techniques and systems disclosed in this specification can reduce the impact of lighting and emphasize skin variance. By acquiring images with the appliance's own image capture device, the approximate location and orientation of face features can be pre-assumed and can avoid the overhead of other face recognition systems. The disclosed methods can ignore face biometrics, and rather use feature locations to normalize an image of a test face. Further, the face recognition techniques are based on a simple, weighted difference map, rather than traditional (and computationally expensive) correlation matching.

[0012] The details of one or more implementations of the subject matter described in this specification are set forth in the accompanying drawings and the description below. Other features, aspects, and advantages of the subject matter will become apparent from the description, the drawings, and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. **1** shows an example of a computerized appliance for implementing the methods disclosed in this specification.

[0014] FIG. **2** shows an example process for detecting a face in a frame acquired by an image capture device of an appliance and for matching the detected face with one of target faces stored on the appliance.

[0015] FIG. **3**A shows an example of a process for preprocessing a color digital image by using an orange-distance filter.

[0016] FIGS. **3**B, **3**C and **3**D are unprocessed and processed versions of an example color image.

[0017] FIG. **4** shows an example of a process for detecting potential presence of a person's face in front of an image capture device and for inferring the person's level of attentiveness.

[0018] FIG. **5** shows a face detector configured to use shape detection profiles generated by an engine to perform face detection in an orange-distance filtered image.

[0019] FIG. **6** shows an example of a process for normalizing an image including information relating to a detected face.

[0020] FIG. **7** shows an example of a process for matching a normalized image of a test face with a normalized image of a target face.

[0021] Like reference numbers and designations in the various drawings indicate like elements.

DETAILED DESCRIPTION

[0022] Computational, memory and/or power reducing techniques for performing low confidence facial recognition are disclosed including use of limited, high-information-value portions of a face to be recognized.

[0023] FIG. **1** shows an example of a computerized appliance **102**. The appliance **102** includes a display **104** and an image capture device **106**, e.g., a camera, located display-side. Under low-load, low-power consumption conditions, e.g., when the appliance **102** rests unused on a support **108**, the display **104** can be turned off while the forward-looking camera **106** can remain on. Methods disclosed in this specification can be implemented by the appliance **102** for providing low threshold face recognition of a user **110** associated with the appliance **102**, where there is a tolerance for a certain level of false positives.

[0024] Panel **100** shows a potential user **110** who is approaching the appliance **102**. In response to the appliance **102** detecting **120** that the potential user **110** stops in front of and faces the camera **106**, the appliance can transition to a new state **102'** to acknowledge the presence and attention of the potential user **110**, as illustrated in panel **100'**. In some implementations, the appliance **102'** acknowledges the presence of the potential user **110** by turning on the display **104**. Further in response to detecting the presence of the potential user **110**, the appliance **102'** can trigger a subsequent process for recognizing **140** the potential user's face.

[0025] Responsive to the appliance **102'** matching **140** the potential user's face to the face of an authorized user, the appliance can transition to a new state **102"** to acknowledge the recognition of the authorized user **110**, as shown in panel **100"**. In some implementations, the appliance **102"** acknowledges the recognition of the authorized user **110** by turning on the display **104**. In other implementations, the appliance **102"** acknowledges the recognition of the authorized user **110** by providing authentication for outer login or other applications that have a low threshold of matching accuracy (or low confidence level that can be tolerated.) For example, the appliance **102"** can be configured to recognize faces of a predetermined group (including a small number) of users that may login on the appliance **102"**, and can present each user with a personalized configuration **142**. For example, to comply with such personalized configurations, the appliance **102"** can modify screen saver slide shows or other appliance non-security preferences.

[0026] The methods disclosed in this specification can adequately recognize a user **110** associated with the appliance **102** without computing resources overhead that is characteristic of other face recognition techniques. Therefore, the face detection and recognition methods described in this specification can be implemented in hardware, for example in graphical processing units (GPUs), of computerized appliances **102**. The disclosed hardware implementation has several advantages. As frames are acquired by the camera **106** of the appliance **102**, the frames represent color, un-rotated digital images. In contrast, when importing an image in a software-implemented image processing application, it is unknown prior to obtaining the image whether the image is black-and-white or color. Another advantage of the disclosed